

Zoonoses of Dairy Cattle

with Reference to Africa

Zoonoses are infections naturally transmitted between vertebrate animals and humans, either directly or indirectly through the consumption of contaminated foods. Traditional zoonotic diseases for which effective control measures and cures are available in affluent countries, are still a cause of morbidity and mortality in humans and animals in developing countries (Wastling et al. 1999, Cosivi et al. 1995). Increasing urbanisation, the growth of livestock production in close proximity to humans, the rising rate of HIV, inadequate hygienic practices, and cultural customs and beliefs exacerbate the transmission, persistence and impact of zoonotic diseases in these regions.

In order to satisfy the constantly increasing demand for milk and milk products in sub-Saharan Africa, dairy production systems in urban and periurban regions are a dynamic and fast-growing sector. Thus, there is an initiative to increase local milk production through the importation of exotic breeds and intensification of livestock production. These developments increase the potential risk of transmission of Bovine Tuberculosis and Brucellosis to humans. This is especially risky

Information is scarce

since approximately 90% of the total volume of milk produced in sub-Saharan Africa is consumed fresh or soured and only a small proportion follows official marketing channels (Cosivi et al. 1995)

The control of zoonotic diseases in West Africa is hampered by poor infrastructures and lack of resources across the different countries. Available diagnostic and prevalence data is often based on small-scale surveys, abattoir surveys and hospital records and does not represent a real epidemiological situation. Inadequate disease-reporting systems and insufficient collaboration and communication between human health and veteri-

nary services further compound the problem (Wastling 1999). Reports often focus on aspects of public health or animals, but seldom tackle both. This deficiency in baseline epidemiological data on the occurrence of zoonotic diseases in humans and animals poses a challenge in identifying the diseases of primary importance to public health in West African countries.

This paper focuses on those diseases that are relevant to humans and livestock. Bovine Tuberculosis and Brucellosis, long-standing public health concerns, are the most widely reported pathogenic bacteria in African dairy cattle.

Tuberculosis and Brucellosis are classical direct zoonoses, both potentially transmitted through contact with ruminants and consumption of improperly treated dairy products. Whereas human infection by these organisms was more commonly a rural problem in farming households and livestock keepers, the distribution and epidemiology of these infections in urban and periurban populations may indeed be changing as urbanisation progresses. The intensification of milk production without adequate measures of processing and the use of unofficial marketing channels increase the risk of transmission. Tuberculosis (*Myco-*



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Pigs scavenging from garbage on street

ZOONOTIC DISEASES CLASSIFIED

- ❖ **Direct:** where diseases are transmitted to a susceptible vertebrate host by direct contact or vector. The distinguishing characteristic of this group is that only one vertebrate host is necessary to maintain the agent. Methods of transmission include direct physical contact, handling of tissues or infective tissue fluids, inhalation of droplet nuclei and ingestion of infected secretions or tissues.
- ❖ **Cyclozoonoses:** this group requires more than one vertebrate host (but no invertebrate host) to complete the agent's life cycle. An example of this group is *Taenia solium* (a parasite of pigs that results in the development of intestinal tapeworms in humans).
- ❖ **Metazoonoses** require a vertebrate and an invertebrate host for perpetuation and are a group with complex "webs of causation".
- ❖ **Saprozoonoses** require a non-animal site, usually soil or water, to develop and/or survive.

(Martin et al. 1987)

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bacterium tuberculosis) is still the single leading cause of human morbidity and mortality due to an infectious agent. Approximately 10% of people infected by the bacteria will progress to fulminant disease at some point during their lives. In immune-suppressed and HIV-positive individuals, this figure rises to 40%. In sub-Saharan Africa, 2 million new cases arise every year and 32% of deaths in HIV-infected individuals is due to Tuberculosis (TB), making it the largest attributable cause of death in this group. As a result of the HIV epidemic, the crude incidence rate of TB had increased in this region from 191 cases per 100,000 in 1990, to more than 250 cases by 1997 in some African countries (Cosivi et al. 1998, WHO 1999).

TUBERCULOSIS

Mycobacterium tuberculosis and *Mycobacterium bovis* are the bacterial agents of tuberculosis in humans and cattle, and infection can result in a chronic disease. *M. bovis* is infectious to humans and can pose a serious zoonotic risk (Gallagher and Jenkins 1998).



Herd in Bamenda Highlands in Cameroon

P. Muchaal

Impact on public health is still unclear

Although the great majority of human TB infections are due to *M. tuberculosis*, largely undetermined portions of the total result from infection by *M. bovis*. Information on human disease due to *M. bovis* is scarce. Where African data have been available, approximately 1-5% of positive cultures from human cases have proved to be *M. bovis* (Daborn et al. 1997, Elasabban et al. 1992, Idigbe et al. 1995). The relatively low isolation rate of *M. bovis* from human TB cases in developing countries, including Africa, may be partly due to the extensive use of microscopy for confirmation of suspected cases, a technique that does not permit differentiation between species of mycobacteria.

Epidemiology

In the case of bovine TB, the infected animal is the main source of infection. Transmission can also occur through contact of infected environmental sources (soil, water). Organisms are excreted in the exhaled air, sputum, faeces, milk, urine, vaginal and uterine discharges and discharges from peripheral lymph nodes. Both *M. bovis* and *M. tuberculosis* are manifested in a primary and a post-primary form (this is dissemination to secondary sites in the body after initial infection), and the site of disease reflects the route of infection.

M. tuberculosis is usually inhaled and leads to primary lesions on the lungs, with occasional extra-pulmonary lesions. On the other hand, *M. bovis* is usually acquired through consumption of contaminated milk. This is the primary means of transmission to sucklings/young and to humans. However, farm workers are more prone to inhalation of infective droplets from diseased cattle (Blood et al. 1984).

In contrast to human infection, the primary lesions in cattle rarely heal spontaneously, but tend to disseminate locally through the natural cavities. In humans, *M. bovis* is less virulent than *M. tuberculosis* and is, as a result, less likely to proceed to post-primary infections of disease.

Housing and zero-grazing predispose the animals to the disease. The highest incidence of bovine TB is generally observed where intensive dairy production is most common, notably in the milk sheds of larger cities (Cosivi et al. 1998) where the bulk of the milk is destined for market in urban regions.

Bovine TB in West Africa

Reports of bovine TB vary among the West African nations. The methods of collecting and presenting information are haphazard and random. One cannot draw, with confidence, any conclusions about the prevalence or incidence of each strain in either humans or animals, nor the route of transmission between the two. Although the risk of transmission is real, there is no published evidence establishing an epidemiological association between tuberculosis in cows and bovine tuberculosis in humans in West Africa. However, due to the limitations on data compilation in the region, the figures presented here are undoubted-

ly a conservative estimate of the prevalence and distribution of the disease amongst the West African nations. Furthermore, TB acquired through the consumption of contaminated raw milk resulting in extra-pulmonary infection may be less likely to be detected or diagnosed than pulmonary disease.

BRUCELLOSIS

Brucellosis is a bacterial zoonosis with worldwide distribution and remains a major source of disease in humans and domesticated animals. For humans, the disease can cause undulant fever. Animal production is primarily affected by the decreased milk production in dairy cows. Three of the six identified *Brucella* species are zoonotic, notably *Brucella abortus*, *Brucella melitensis*, and *Brucella suis*, and are transmitted directly or indirectly to humans from cattle, sheep and goats, and pigs respectively.

Epidemiology

The three species of *Brucella* of concern to public health are of bovine, ovine-caprine and swine origin. Although bovine Brucellosis is the most widespread form, *Brucella melitensis* is by far the most important clinically apparent and pathogenic disease in humans. Sheep, goats and their products remain the main source of infection, although recently *B. melitensis* has also begun to emerge as a disease of cattle (Corbel 1997).

Humans become infected by ingestion, direct contact, inhalation, or accidental inoculation by penetration through mucous membranes of the eyes, throat and lungs and/or intestinal mucosa, or through skin abrasion or injury. Milk, cream, and fresh cheese are the main source of human Brucellosis. Excretion in milk may attain its highest level at the beginning of lactation and then decline to a few bacteria, but may persist during successive lactation periods. During cheese production, the number of bacteria decline with the acidification produced by the lactic bacteria. Therefore, survival depends on the type of cheese and the ripening involved. *Brucella* bacteria are also destroyed by pasteurisation.

Excretion from the genital tract from an abortion or normal birth, which continues for some weeks, is the second most important source of infection for humans. For animals within the same herd, this is

the major source of infection. Infection can occur by direct contact or indirect transmission through contaminated items in the environment. *Brucella* survives in soil, water and manure depending on the material, temperature and sun exposure. Bacteria can also contaminate drinking water. Airborne dust or droplets may cause transmission, particularly so when high-pressure jets or water are used during the washing of premises. Meat products, mainly spleen, liver, genital organs, lymph nodes and meat with remnants of lymphatic tissue constitute an important source of human and animal infection.

Brucellosis in West Africa

Brucellosis is regarded as a major problem among ruminants in Africa (Wastling et al. 1999), yet the true incidence of human brucellosis is unknown and there is scant evidence of the impact of this disease on public health in West Africa. Clinical signs of Brucellosis in humans can be misleading with cases manifesting gastrointestinal, dermal, neurologic and respiratory problems. Brucellosis symptoms can mimic those of other illnesses (such as malaria) and cases may therefore remain undetected or misdiagnosed.

According to the Office of International Epizootics (OIE 1999) in Cameroon, Mali and the Ivory Coast were the only West African countries cited as either reporting or suspecting the presence of bovine *Brucella*. While some areas may have a high incidence of acute infections, the low incidence reported in other known Brucellosis endemic areas might reflect low levels of surveillance and reporting.

Furthermore, factors such as livestock species raised, methods of food preparation, heat treatment of dairy products, and direct contact with animals also influence risks to the human population. In animals, the presence and transmission of *Brucella* is moderated by an interrelationship of factors including climate, types of production systems (nomadic/transhumance or sedentary; extensive vs. intensive), herd size, livestock breeds and the age of the animal (Blood 1984, Plommet et al. 1998).

Most studies of Brucellosis in West Africa focus either on animals or humans. Only one study (Gidel 1974) investigated the prevalence in both livestock and people. Results indicated that the prevalence of

brucellosis in all ruminant species was highest in the woody savannah and decreased in the savannah and dry zones.

Akapo (1987) conducted a serological study of animal Brucellosis in five West African countries. The prevalence of the disease was similar for Benin, Cameroon, and Burkina Faso (10.4-12.3%), but was relatively higher in Niger (30.5%) and Togo (41%). In general, there appeared to be greater abundance of infected animals in intensive production systems at the periphery of urban centres and in urban areas than in the more traditional rural systems.

CONCLUSIONS

Traditional zoonoses are present in some African environments. However, the risks of transmission and impact on public health are still unclear.

Education and improved sanitation could greatly reduce the incidence of some of these diseases. Proper hygienic practices and good husbandry in many situations can go a long way in ameliorating the transmission of zoonotic diseases. Control strategies in livestock need to be adapted to local conditions.

In the absence of sufficient veterinary supervision, the intensification of dairy production may be the single most important determinant in increasing the prevalence of bovine TB in humans and animals. Milk plays a key role in the transmission of TB and brucellosis and therefore may be the most practical level for inter-

vention. Pasteurisation or other adapted techniques should be evaluated and implemented concurrent with the establishment of a dairy producing system. In the absence of the infrastructure and technologies for the commercialisation of safe milk, education is the most effective tool for prevention of transmission to humans. Incentives to produce TB-free milk appear to be successful. In Ghana, farmers are offered a premium price for their milk if it is free of *M. bovis* when presented for sale (Wastling et al. 1999).

Systemic vaccination for Brucellosis (and to a lesser extent tuberculosis) is recommended in the absence of an adequate surveillance system and where the prevalence is greater than 5%. Vaccination increases individual resistance to systemic infection, and in infected animals decreases the probability of placental infection, abortion and massive shedding of infectious organisms. These combined facts interact at the herd level, to confer good overall protection, provided that all individual animals are properly vaccinated.

Carefully planned epidemiological studies in (peri)urban regions, in combination with appropriate diagnostic assessment need to be carried out to determine the risks of exposure and acquisition of diseases. These investigations also assist in determining whether transmission is occurring from human to human or animal to human, thereby identifying control points for the various diseases.

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